Video Quality Research

Outputs

- Digital video quality measurement technology.
- Journal papers and national/international video quality measurement standards.
- Technical input to development of U.S. policies on advanced video technologies.
- A national objective and subjective digital video quality testing laboratory.

Objective metrics for quantifying the performance of digital video systems (e.g., direct broadcast satellite, digital television, high definition television, video teleconferencing, telemedicine, Internet, and cell phone video) are required by end-users and service providers for specification of system performance, comparison of competing service offerings, network maintenance, and use optimization of limited network resources. The goal of the ITS Video Quality Research project is to develop the required technology for assessing the performance of these new digital video systems and to actively transfer this technology to other government agencies, end users, standards bodies, and the telecommunications industry, thereby producing increases in quality of service that benefit all end users and service providers.

To be accurate, digital video quality measurements must be based on perceived "picture quality" and must be made in service. This is because the performance of digital video systems is variable and depends upon the dynamic characteristics of both the input video and the digital transmission system. To solve this problem, ITS has continued to develop new measurement paradigms based upon extraction and comparison of low bandwidth perception-based features that can be easily communicated across the telecommunications network. These new measurement paradigms (now commonly known throughout the world as "reduced reference" measurements) have received three U.S. patents, have been adopted as the North American Standard for measuring digital video quality (ANSI T1.801.03-2003), have been included in two International Recommendations (see Recent Publications below), and are currently being used by hundreds of individuals and organizations worldwide.

During FY 2004, international standardization of the ITS General video quality metric (VQM) was completed with the publication of ITU-R Recommendation BT.1683 and ITU-T Recommendation J.144R. These new international recommendations provide end-users and service providers with standardized methods for measuring the video quality of standard definition television (SDTV) systems. One hundred and seventy-two new Cooperative Research and Development Agreements (CRADAs) were implemented with U.S. companies/individuals and 91 new Evaluation License Agreements (EVAs) were implemented with foreign companies/individuals. These CRADAs and EVAs provide companies with an easy mechanism for evaluating ITS video quality measurement technology and software before signing commercial licensing agreements.

During FY 2004, ITS worked to extend the above patented and standardized video quality measurement techniques to two new areas; high-definition

Figure 1. HDTV subjective viewing room.

TV (HDTV) and multimedia (MM) systems. HDTV and MM differ from SDTV in image resolution, viewing distances, display type, and user expectations. The differences between SDTV and HDTV/MM necessitate the creation of new subjective and objective testing facilities and procedures. Figure 1 shows a new HDTV subjective viewing room that was used to conduct ITS's first HDTV subjective quality experiment. Figure 2 shows a new HDTV transmission/reception system that was used to generate transmission impairments for this HDTV experiment. Viewer ratings of HDTV compression and transmission quality will be used to see if ITS's SDTV technology scales to HDTV (HDTV has approximately 4 times the resolution of SDTV). Similar investigations are being performed for MM resolution systems, which typically have only 1/4 to 1/16 the resolution of SDTV.

Figure 2. HDTV transmission/reception system.

The current VQM software for the CRADAs and EVAs mentioned above is limited to bench testing, where video from the source and destination ends of a video system under test must be present at a single PC. Work began in FY 2004 to expand the existing VQM software tools to include new end-to-end video quality monitoring capabilities. This new software tool runs on two PCs, one located at the source end and the other located at the destination end. The two PCs communicate their reduced reference features via the Internet. Using the new software tools, users and service providers will be able to monitor their end-to-end digital video quality.

Recent Publications

M. Pinson and S. Wolf, "A new standardized method for objectively measuring video quality," *IEEE Transactions on Broadcasting,* v. 50, n. 3, pp. 312-322, Sep. 2004.

ITU-R Recommendation BT.1683, "Objective perceptual video quality measurement techniques for standard definition digital broadcast television in the presence of a full reference," approved Jun. 2004.

ITU-T Recommendation J.144R, "Objective perceptual video quality measurement techniques for digital cable television in the presence of a full reference," approved Mar. 2004.

ITU-T Recommendation J.149, "Methodological framework for specifying accuracy and cross-calibration of video quality metrics (VQM)," approved Mar. 2004.

M. Pinson and S. Wolf, "The impact of monitor resolution and type on subjective video quality testing," NTIA Technical Memorandum TM-04-412, Mar. 2004.

M.H. Brill, J. Lubin, P. Costa, S. Wolf, and J. Pearson, "Accuracy and cross-calibration of video quality metrics: New methods from ATIS/T1A1," *Signal Processing: Image Communication,* v. 19, pp 101-107, Feb. 2004.

S. Wolf, "Color correction matrix for digital still and video imaging systems," NTIA Technical Memorandum TM-04-412, Dec. 2003.

Further information can be found on the Video Quality Research home page at http://www.its.bldrdoc.gov/n3/video.

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